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Overview of Alarms, Interlocks and Other Safety Controls

Activity/ System/ Equipment	Operating Parameters Monitored	Alarms	Trips	Automatic Controls	Overpressure	Notes
Tanks – Reagent Storage (RST) A-1.002A/B	1. Level 2. Temperature 3. Pressure 4. Flow (RST supply) 5. Temperature (RST supply)	1. Level Hi (38") Lo (10") Hi Hi (42",44") Lo Lo (6") 2. Temperature Hi (130F-RSTA) Lo (40F-RST A) Hi Hi (140F-RST A) Lo Lo (30F-RST A) Hi (140F-RST B) 3. Pressure Hi (50 psig)	1. Hi Hi level form either of 2 level switches (1st level switch 42", 2nd level switch 44") closes reagent/water supply valve and RFP recirc valve to stop tank fill (two level switches per tank) 2. Lo Lo level (6") shuts off heater in RST A 3. Lo Lo level (6") in either RST with associated outlet valve to RFP's open will stop RFP. (Note 1) 4. Hi Hi temperature (140F) in RST A shuts off heater. 5. Only one RFP can be operated at a time	1. Pressure control valves discharge tank vapors to vent knock-out drum and supply nitrogen to RST's to maintain RST pressure within 5-10 psig 2. Temperature controller cycles RST A heater off and on to control temperature at 40F-150F ±3F in AUTO mode.	Relief valve	1. Lo Lo level override allows RFP to operate with Lo Lo level for purpose of emptying tanks
Tanks – Relief Vent Tank (RVT) A-1.004	1. Pressure	1. Level HI (6") 2. Pressure Hi (50 psig)	1. To prevent backflow into the nitrogen system, isolation valve (AOV-9108) closes if the pressure in the RVT exceeds the pressure in the nitrogen receiver tank	1. Pressure control valve maintains RVT pressure at 5 psig	Relief valve	
Tanks –Surge (ST) A-1.201A/B	1. Level 2. Temperature 3. Pressure 4. Flow (ST discharge) 5. Temperature (outlet to waste totes)	1. Level Hi (44") Lo (10") Hi Hi (48",49") Lo Lo (6") 2. Temp Hi (150F) Lo (60F) 3. Pressure Hi (40 psig)	1. Hi Hi level from either of 2 level switches (1st level switch 48", 2nd level switch 49") closes inlet supply valve from MTV/LRV to stop tank fill 2. Lo Lo level (6") in either ST with associated outlet valve to WTP open will stop WTP.	Pressure control valves discharge tank vapors to vent knock-out drum and supply nitrogen to ST's to maintain ST pressure within 5-10 psig	Relief valve	1. Lo Lo level override allows WTP to operate with Lo Lo level for purpose of emptying tanks
Tanks - Reagent Charge Tank (RCT) A-1.102	1. Level 2. Flow (outlet)	1. Level Hi (38")	1. Hi Hi level (44") closes inlet supply valves from RST and MTV to stop tank fill.	N/A	Relief valve	

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Tanks - Waste Gas Knockout Drum (WGKD) A-1.003	1. Level (local gage only) 2. Pressure 3. Temperature (inlet)	1. Level Hi (2") 2. Level Hi Hi (6") 3. Pressure Hi (130 psig) 4. Temperature (180F)	1. Hi Hi WGKD inlet temperature (200F) closes WGKD vapor out key locked isolation valves (AOV-3031, 3032) to protect downstream carbon and closes process gas supply valve (AOV-1144) to GR and opens GR bypass (AOV-1139) and WGKD return to MTV (AOV-3048) to protect GR carbon.	N/A	Relief valve	1. Operators manually control release of WGKD contents to waste gas system via double key lock valves (AOV-3031, 3032)
Reactors - Munitions Treatment Vessel (MTV) A-1.001	1. Level 2. Temperature 3. Pressure	1. Level Hi (20.5") Lo (2") Hi Hi (23") Lo Lo (1") 2. Temp Hi (140F) 3. Pressure Hi (1 psig) (Note 1)	1. Hi Hi level (23") from either of 2 level switches in MTV closes MTV reagent supply valve, LP spray valves, RCT supply valve, and recirc loop supply valve to MTV to stop MTV fill 2. Hi Hi level (23") from either of 2 level switches in MTV places HP wash pump in bypass flow mode to stop MTV fill 3. Lo Lo level (1") stops RP. 4. To prevent backflow into the nitrogen system, isolation valve (AOV-9108) closes if the pressure in the MTV exceeds the pressure in the nitrogen receiver tank. 5. Double key lock valves from MTV to ST's (AOV-6006, 6008) close automatically 5 seconds after flow stops	1. Pressure control valve supplies nitrogen to maintain MTV pressure at 20 psig	Relief valve	1. MTV high pressure alarm warns operators not to open MTV while pressurized 2. Operators manually control release of MTV contents to Surge tanks via double key lock valves (AOV-6006, 6008).

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Reactors - Liquid Reactor Vessel (LRV) R-1.201	1. Level 2. Temperature 3. Pressure	1. Level Hi (38") Lo (15") Hi Hi (45") Lo Lo (12") 2. Temperature Hi (130F) Lo (40F) Hi Hi (140F) 3. Pressure Hi (1 psig)	1. Hi Hi level (45") from either of 2 level switches in LRV stops sump pump, closes LRV reagent supply valve, and recirc loop supply valve to LRV to stop LRV fill 2. Lo Lo level (12") trips heater and agitator. 3. To prevent backflow into the nitrogen system, isolation valve (AOV-9108) closes if the pressure in the LRV exceeds the pressure in the nitrogen receiver tank. 4. Hi Hi temperature (140F) trips heater 5. Double key-lock valves from LRV to ST's (AOV-6006, 6008) close automatically 5 seconds after flow stoppage	1. Pressure control valve supplies nitrogen to maintain LRV pressure at 20 psig 2. Temperature controller cycles LRV heater off and on to control temperature at 40F-150F ±3F in AUTO mode.	Relief valve	Operators manually control release of LRV contents to Surge tanks via double key-lock valves (AOV-6006, 6008).
Heat Exchangers - Liquid Reactor Cooler (LRC) EA-1.203	1. Temperature (process inlet) 2. Temperature (process outlet) 3. Temperature (cooling water outlet) 4. Flow (cooling water inlet)	1. Temperature (process outlet) Hi (140F) 2. Pressure (cooling water inlet) Hi (later psig)	N/A	N/A	N/A	Manual control of cooling water to LRC
Heat Exchangers - Gas Reactor Cooler (GRC) EA-1.101	1. Temperature (process outlet) 2. Pressure (process outlet) 3. Flow (cooling water inlet)	1. Temperature (process outlet) Hi (210F) 2. Pressure (process outlet) Hi (later psig)	N/A	N/A	Relief valve (cool-ing water outlet)	
Heat Exchangers - Waste Gas Chiller (WGC) EA-1.301	1. Temperature (process outlet) 2. Pressure (process inlet) 3. Flow (cooling water inlet)	1. Pressure (process inlet) Hi (25 psig)	N/A	N/A	Relief valve (cool-ing water outlet)	
Heat Exchangers - Waste Gas Heater (WGH) EA-1.302	1. Temperature (process outlet) 2. Humidity (process outlet) 3. Flow (steam inlet)	1. Humidity (outlet) - Hi (50%)	N/A	N/A	Relief valve (steam system)	Manual control of steam to WGH
Sumps - Dykes for RST and ST skids	N/A	Level Hi (2")	N/A	N/A	N/A	Collect system leakage
Sumps - Trailer sump	Level	1. Level Hi (6") Hi Hi (9") X Hi (12")	1. Lo level (6") stops sump pump	N/A	N/A	Sump pump manually started by operators based on sump level alarms

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Pumps - (RFP,RP,WTP) P-1.001 A/B P-1.201 A/B P-1.202	1. Pressure (suction) 2. Pressure (discharge) 3. Differential pressure 4. Bearing wear 5. Flow (volume and rate) 6. Level (seal pot) -local gage only 7. Pressure (seal pot) 8. Differential pressure (MTV strainers)	1. Differential pressure Hi RFP (116 psig) RP (40 psig) WTP (later psig) 2. Differential pressure Lo RFP (50 psig) RP (25 psig) WTP (25 psig) 3. Level (seal pot) Lo (8.5") 4. Differential pressure (MTV strainers) Hi (5 psig)	1. Lo Lo level (6") in either RST with associated outlet supply valve to RFP open stops RFP (Note 1) 2. RFP outlet valve to liquid processing system (AOV-0156) closes automatically to prevent backflow if pressure in liquid processing system exceeds RFP outlet pressure. 3. Lo Lo level (1") in MTV or Lo Lo level (12") in LRV with LRV outlet supply valve to RP open stops RP. (Note 1) 4. Lo Lo level in either ST with associated outlet supply valve to WTP stops WTP. (Note 1)	N/A	N/A	1. Lo Lo level override allows RFP's, RP's, and WTP to operate with Lo Lo level for purpose of emptying tanks
Pumps - Agent Injection Pump (AIP) P-1.203	1. Pressure (discharge)	1. Pressure (discharge) Hi (150 psig) 2. Pressure (diaphragm) Hi (2 psig)	1. Hi HI discharge (180 psig) pressure stops AIP. 2. Hi diaphragm pressure (2 psig) stops pump.	Adjustable flow rate	N/A	
Pumps - Process Gas Vacuum Pump (PGVP) C-1.101	1. Pressure (discharge) 2. Pressure (suction) 3. Differential Pressure (strainer)	1. Pressure (suction) Hi (30 psig) 2. Pressure (suction) Hi Hi (85 psig) 3. Pressure (discharge) Hi (130 psig) 4. Pressure (discharge) Hi Hi (150 psig) 5. Pressure (diaphragm) Hi (20 psig) 6. Differential pressure (strainer) Hi (5 psig)	1. Hi PGVP discharge pressure (>10 psig), Hi Hi PGVP suction pressure (>30 psig), Hi Hi Gas Reactor Knock-out Drum inlet temperature (>350 9F), or Hi Hi PGVP discharge pressure (>150 psig) will not allow the PGVP to start. 2. Hi Hi PGVP suction pressure (>30 psig), Hi Hi Gas Reactor Knock-out Drum inlet temperature (>350 9F), or Hi Hi PGVP discharge pressure (>150 psig) stops PGVP. 3. PGVP bypass valve (AOV-1121) closes when the PGVP is started 4. LO PGVP suction pressure (<6 psia), Hi HI PGVP discharge pressure (>130 psig), or 5 sec delay after PGVP stoppage opens PGVP bypass valve (AOV-1121)	N/A	Relief valve	

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Pumps – High Pressure Wash Pump (HPWP) P-1.501	1. Pressure (discharge) 2. Pressure (suction) 3. Temperature (discharge) 4. Pressure (oil) 5. Pressure (bypass flow)	1. Pressure (suction) Lo (35 psig) 2. Pressure (discharge) Hi (5200 psig) 3. Pressure (discharge) Lo (4000 psig) 4. Temperature (oil) Hi (150F) 5. Pressure (oil) Lo (30 psig) 6. Temperature (discharge) Hi (130F) 7. Temperature (discharge) Lo (65F)	1. MTV Hi Hi level (23") from either of 2 level switches places HPWP in bypass flow mode to stop MTV fill 2. To prevent backflow into the high pressure wash system, MTV HP spray valves AOV-5039, 5041, 5042 close if MTV pressure exceeds HPWP discharge pressure	Pressure control valve maintains pump discharge pressure at set point	1. Rupture disk on pump bypass 2. Relief valve at pump discharge	
Pumps - Sump Pump P-1.002	1. Pressure (discharge)	N/A	1. LRV Hi Hi level (45”) from either of 2 level switches or sump Lo level (6") stops sump pump 2. To prevent backflow into the sump, sump pump outlet valve (AOV-6003) closes when liquid processing system pressure exceeds sump pump discharge pressure	N/A	N/A	
Moisture Separators - Gas Reactor Knockout Drum (GRKD) A-1.101	1. Level (local gage only)	1. Level Hi (2") 2. Level Hi Hi (6")	N/A	N/A	Relief valve	
Moisture Separators - Vent Knockout Drum (VKD) A-1.005	N/A	Level Hi (6")	N/A	N/A	N/A	1. Operator manually drains drum to portable container on Hi level alarm
Carbon Filters - Gas Reactor (GR) R-1.101	Temperature (3 elements in carbon bed)	1. Temperature Hi (185F) -3 elements (Note 1) 2. Level Hi (6")	N/A	N/A	N/A	1. High temperature in downstream portion of GR carbon bed indicates upstream carbon impregnate is being expended.
Carbon Filters - Carbon Adsorption Unit (CAU) B-1.101A/B	N/A	3. N/A	N/A	N/A	N/A	
Carbon Filters - Carbon Filtration Unit (CFU) FLT-1.001	Differential pressure (each filter)	1. Pressure differential (process trailer to Bldg 3445 east chamber) Hi (0.49 “ water)	1. Only one motor can be run at a time	Flow controller at discharge of fan modulates damper at filter inlet to maintain constant flow of 500 CFM	N/A	

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Mixer - Steam Condenser EA -1.202	1. Pressure (inlet) 2. Temperature (outlet)	1. Pressure (inlet) Hi (150 psig) 2. Temperature (outlet) Hi (140F)	N/A	N/A	N/A	
Utilities - HVAC Chiller HVAC 1.501	1. Pressure (discharge) 2. Flow (individual indication for RFPs, WTP, GRC/PGVP, WGC, RPs, LRC, air handlers) 3. Temperature (discharge) 4. Differential pressure (pump)	1. Pressure (discharge) Hi (60 psig) 2. Pressure (LRC inlet) HI (later psig) 3. Temperature Hi (80F) 4. Flow (chilled water pump inlet) Lo (50 GPM)	Later	Later	Relief valves (LRC, GRC, WGC)	
Utilities - Steam Generator B-1.004	1. Flow (HP wash) 2. Pressure (HP wash)	N/A	1. To prevent back flow into the steam system, steam supply valve (AOV-9201) closes if the liquid processing system pressure exceeds steam pressure 2. Lo flow or Hi temperature shuts off heater	1. Float tank level automatically maintained by float valve	Relief valve	Operator opens steam isolation valves to supply steam to WGH, HP wash, liquid process piping, LRV, MTV, and LP sprays
Utilities - Process water	1. Temperature 2. Pressure	1. Temperature Hi (75F) 2. Temperature LO (40F) 3. Pressure HI (90 psig) 4. Pressure Lo (20 psig)	1. To prevent back flow into the process water system, water supply valve (AOV-9310) closes if the liquid processing system pressure exceeds process water pressure	2. Pressure control valve automatically supplies water to HVAC chiller on low pressure 3. Float valve automatically supplies water to steam generator on low float tank level		Operator opens water supply valves from DCIS to supply water to RST, LP sprays, and liquid processing system
Utilities - Instrument Air B-1.005	1. Flow 2. Pressure	1. Later	1. Later	1. Compressor automatically loads and unloads to maintain air receiver pressure	Relief valve	
Utilities - Nitrogen B-2.002	1. Pressure 2. Differential Pressure (strainer)	1. Later	1. Later	1. Later	Relief valve	
Misc - Valve Packing Leakoff	N/A	1. Pressure (packing cavity) Hi (2 psig)	N/A	N/A	N/A	
Misc - Munition Loading and Breaching	Later	Later	Later	Later	Later	